



TOO LITTLE, TOO LATE?

Fatal accident involving *Red Sales* aerobatic team near
East Sale, Victoria, 15th August 1962

At 1344hrs on the 15th August 1962, four Vampire jet trainer aircraft took off from East Sale for a period of formation aerobatic training in the area southeast of the airfield within the height band of 500-5,000 ft.

Arrangements had been made with ATC to operate on a discrete frequency (142.92 MHz) so that they would not interfere with normal operations. This frequency was not monitored.

At approximately 1400hrs, a Dakota aircraft reported to the East Sale tower an observation of black smoke and an explosion in the Dutson Bombing and Gunnery Range area. Investigation revealed that all four Vampire aircraft had crashed 7.5 nm southeast of the airfield. Rescue and fire fighting vehicles were despatched to the area immediately. Shortly afterwards it was ascertained that all six members involved had been killed.

To many around at the time, the accident was almost beyond comprehension - not one, but four aircraft lost in a single instant. The accident, understandably, attracted considerable media coverage both locally and overseas.

The *Red Sales* accident is one of the more tragic episodes in RAAF non-combat flying safety (ranking alongside the loss of Lincoln A 73-011 at Amberley on 19 Feb 48 (*Spotlight* 3/92), Caribou A4-233 in PNG on 28 Aug 72, and the loss of Boeing 707 A20-103 near East Sale on 29 Oct 91).

In this anniversary year (1996), where the celebrations will include many formation (and solo) air displays, it is worth taking a few moments to review the following tragedy and, perhaps, learn something positive from it.

The *Red Sales* team was practising for a RAAF Open Day Display on the 16th September 1962. The four aircraft struck the ground almost simultaneously in the final stages of completing a low-level barrel roll. They crashed in close proximity to each other in a shallow dive and at an estimated speed of over 300 kts. The No 3 in the formation struck the ground slightly ahead and approximately 150 yards to the port side of the others. On impact, three aircraft exploded - wreckage and debris was scattered over a distance of approximately half a mile. The wreckage of No 3 in the formation was not as completely disintegrated as the others as it had 'levelled out' just prior to impact.

Personnel aspects

All four pilots were staff members of the Central Flying School (CFS), as well as members of the aerobatic team. Additionally, two other CFS staff members were flying as passengers: one as an observer, nominated to eventually replace one of the team members; the other to assist with operation of one aircraft's ancillary controls where the pilot was flying from the right seat.

All pilots were very experienced. Their total flying hours were in the range 2 500-4 000, and hours on type 460-1 300. They were all medically fit for flying, although an examination of the formation leader's medical documents revealed that he had been medically grounded during 1959 for 18 months. Further investigation revealed also that during 1956 there was at least one occasion during which he had suffered a temporary disorientation.

The formation leader was selected as leader of the team because he was considered by his Commanding Officer to be the most suitable officer. Although he had joined the *Red Sales* only a short time before the accident, he was considered by his superiors to possess the desired qualities as an officer and a pilot.

One fact which influenced the Commanding Officer in his choice was the need to obtain a leader who could be expected to remain at East Sale for two years or more. The other members of the team had been at East Sale for some time and their instructional tour was therefore drawing to a close. Other factors which led to the leader's appointment were:

- he was assessed as above average as a pilot and instructor;
- he had been a fighter pilot with overseas forces in Malta and Malaya (he had been a Flight Commander in Malaya);
- he had approximately 700 hrs Vampire and 350 hrs Sabre flying, and considerable experience in formation flying in both aircraft types; and
- he was very methodical in his approach to his duties and generally gave the impression of reliability and attention to detail.

At the time of the accident the formation leader was leading his fifth aerobatics sortie - one in June, another in July and the remainder in August. During August, the team had settled down to an increased rate of training which was to be further increased to two sorties per week.

There was ample evidence of the leader's stability and sound temperament. Most witnesses amplified his reserved and careful approach to flying, and believed it unlikely he would introduce any new manoeuvre or variation to the display sequence in which the formation as a whole was not thoroughly familiar and practised. It was also considered that he would not intentionally set about performing manoeuvres below the specified minimum height.

There was no evidence that personal problems, overwork, or undue emotional or physical stress might have influenced his capability as a pilot and leader of a formation. Evidence as to his personal habits would indicate to the contrary, particularly as regards the consumption of alcohol.

Personnel who had critically observed the team during previous practice sessions over the airfield, assessed the minimum height to be in

Formation routine

During training, many favourable observations had been made as to the efficiency and reliability of the team. A number of people on the unit had flown as ballast crew. The pattern set by the

team indicated that they were not prone to taking unnecessary risks, flying in accordance with their flight briefing.

The standard routine was to carry out a sequence of loops, steep turns and barrel rolls in that order, finishing with a downward bomb burst. The speeds for all manoeuvres were in the vicinity of 300 kts and 3g accelerations were seldom exceeded. On all barrel rolls to the left, the routine was to complete a full roll and then to enter a turn in the same direction.

the order of 500 ft, although one aircrew member who flew with the team had cause to comment regarding a fly past before commencing a loop. The height on that occasion was read as 300 ft on the aircraft altimeter.

Flight authorisation and aircraft serviceability

The flight authorisation in the Form A 71 showed the flight correctly authorised as a '*Red Sales* formation exercise as briefed'. No mention was included relating to safety heights. As the *Red Sales* were led by one selected pilot who performed a fixed routine within limits prescribed by the Commanding Officer at CFS, it was considered there was no need for special written orders.

A study of the aircraft log books and the E/E 77s revealed that there were no recurring unserviceabilities on any aircraft and all were fully serviceable for flight.

Briefing

The customary procedure prior to each flight by the *Red Sales* was for the formation leader to brief the members of the team as a group. It was normal for the leader to cover the following aspects in his briefing:

- general information on the nature of the mission;
- aircraft allocation to the members;
- fuel load to be carried;
- R/T frequencies;
- starting time; and
- a detailed description of each manoeuvre in the sequence to be followed.

The briefing on this occasion was of an informal nature. It was conducted by the formation leader with the members of the team sitting around the fire in the crew room. A pilot who was in the vicinity of the briefing room during the greater part of this time overheard much of what was discussed and was convinced that the briefing was thorough and relevant. He distinctly remembered the concluding remark made by the briefing officer who stated:

“I shall carry out a routine sequence of manoeuvres and try not to introduce anything new, nor omit anything.”

Weather and topography

Reliable reports from the impact area and the spotter Dakota assessed the local weather as fine and virtually cloudless with very slight turbulence.

The terrain in the vicinity of the crash was extremely flat with about a one degree gradual slope rising from 50-100 ft AMSL. An east-west bitumen road close to the impact area and bombing and gunnery range, ran alongside an open drain with power lines on the south side.

Eye witness accounts

Several civilian witnesses working in the area observed the formation carrying out their training sequence. In general they had viewed the aircraft, under conditions of good visibility, carrying out loops, steep turns and barrel rolls at low altitude. In all the manoeuvres, the witnesses were impressed by the precision positioning of the aircraft in tight formation.

Only one witness gave his full attention to the last manoeuvre preceding the crash. The area was one in which aircraft from East Sale were continually operating at low level on training and armament exercises. For the most part, the witnesses had been preoccupied and only noticed the formation when it came into their immediate field of view or their attention was drawn to it. No witness, except a former RAAF pilot, had a complete picture of the final manoeuvre and crash.

While there was insufficient evidence to establish the exact sequence of aerobatic manoeuvres and altitudes flown preceding the accident, eye witness accounts suggest that the normal practice routine was being carried out and at altitudes down to the minimum prescribed, if not lower. Loops and steep turns were observed prior to the formation commencing a climb from which the fatal barrel roll to the left was initiated.

During a test in which a Vampire aircraft was flown overhead on simulated runs, the one witness to the final manoeuvre displayed a sound ability to assess height fairly accurately and indicated that the four aircraft had entered the fatal barrel roll at about 500 ft, with a nose-up attitude of about 10°, which resulted in a maximum height gain of not more than a few hundred feet. After passing the inverted position the formation appeared to the witness to dive at a steep nose-down angle, flattening in the final stages before striking the ground.

From a study of the impact area and discussion with witnesses, it was assessed that the formation climbed on a heading of 265 degrees M which positioned them immediately south of Seacombs Road, two miles from the impact point. The final barrel roll to the left was then commenced which led to impact with the ground immediately south of the road.

Wreckage site examination

There was some intermingling of the wreckage of Lead and No 2 on the surface of their respective craters. Positive identification was established from identifiable components such as brake 'Maxaret' units which were deeply buried in the crater.

The individual aircraft flight paths at the time of impact were determined by compass sightings taken through the clearly obvious centre-line of each impact crater.

In comparing the individual flight paths and impact points at the moment of the crash, and in relating this comparison to the fatal manoeuvre, the following deductions were made:

- No 3, being on the high side had appreciated the dangerous proximity of the ground during the final stage of the roll. He had broken formation, levelled his wings, and had made every effort to pull up before striking the ground.
- No 4 had also appreciated the dangerous situation and had taken similar action to that of No 3, but slightly later. It is possible that the sudden movement of No 3 prompted the action of No 4. The slope of the ground, when related to the flight path of No 4 immediately prior to impact, was such that with wings-level his left wing could have struck the ground first.

- No 2 had an impact flight path truly parallel with that of No 4. The position of No 2 in the formation was such that in the final stage of the roll he was looking up at the leader and would not have appreciated the proximity of the ground.
- Lead had an impact flight path which was 10° to the right of the parallel impact flight paths of No 2 and No 4.

All the damage to the airframe structures of the four aircraft was consistent with the aircraft striking the ground at high speed.

In every case the control surfaces were either still attached to the main surfaces or had been torn from the hinge points, as could be expected from the broken-up condition of the wreckage. There was no evidence to suggest that any control surface has failed or become detached in flight.

Broken control cables had failed with the characteristic fraying associated with grossly excessive tension loads.

No evidence was found to suggest there had been a midair collision or birdstrike.

The lead aircraft had struck the ground right wing low in a nosedown attitude. The outer portion of the right mainplane had broken off relatively intact. The aircraft had then overturned as was evidenced by the turf marks on the top surface of the port mainplane and the ruptured condition of the booms.

No 2 aircraft had impacted in a level attitude but at a high rate of descent. The plan form of the aircraft was plainly visible in the soft ground. The fuel tanks had also burst and the fuel had ignited.

No 3 aircraft was not nearly as broken up as were the three other aircraft. In fact, the instrument panel of this aircraft was found relatively intact. The damage sustained on impact was consistent with a high speed but low rate of descent.

No 4 aircraft had struck the ground in a tail-down attitude. The skin of the underside of the left mainplane had virtually disappeared but portion of the upper surface skin of this mainplane had burst from its securing rivets and was quite bright and clean. Much of the right mainplane undersurface was still attached, and the top surface was distorted by an explosion inside the mainplane. The aircraft must also have had a high rate of descent.

The turbine discs of Lead, No 2 and No 4 aircraft became detached from the engines and it was evident from the condition of the turbine blades that these engines were under power at the time of impact.

The turbine disc of No 3 aircraft was still attached to the shaft of the engine, due to the lesser rate of descent of this aircraft. The turbine wheel had dissipated its inertia by grinding away the nozzle guide vanes of the engine. Here again it was evident that the engine had been under power at the time of impact.

Virtually the only aircraft instrument that yielded information was the clock of No 3. This showed a trip duration of 25 minutes and had stopped at 1403 hrs.

No evidence was found that would lead to the belief that any other item of equipment in the aircraft had in any way contributed to the accident.

Discussion of the evidence

Formation flying requires great concentration on control and positioning. It is essential that all formation members rely implicitly on the leader for altitude, attitude and safety considerations. They concentrate solely on precision positioning. It follows that an explanation as to why the leader allowed a hazardous situation to develop will account for all aircraft crashing. No 3 attempted individual recovery at a very late stage despite the prerogative of the leader to carry out this action for all. This fact in itself indicates there may have been something wrong with the leader or lead aircraft, as the formation leader should have had the best appreciation of the situation.

Investigation determined that all engines were under power at the time of impact. Further, had power failure occurred in the lead aircraft the formation would have lost its identity immediately, and at a height sufficient to enable breakaway action to be taken. The leader would not have aggravated the situation by adopting such a flight profile.

There was no evidence to suggest that an unserviceability of engine, airframe, or other equipment was the direct or indirect cause of the accident.

It was considered possible the leader could have encountered control loss due to foreign object jamming. During recovery from a barrel roll, increasing back pressure is required on the control column. This is particularly so as the angle of bank reduces to around about 20°-30°. Thus, any restriction which did not occur before this required amount of back stick was needed would not have been evident to the pilot before this stage of the roll was reached.

A pilot confronted with this situation at 600-700 ft would most probably resort to 'pulling hard'. The natural tendency would be to use both hands on the control column. In such circumstances it would be foreign to remove one hand to use the R/T button on the throttle lever. Also, in such a situation the manoeuvre would follow a flight path closely akin to the last stages of a normal barrel roll. The aircraft would be decreasing its angle of dive, which would give the other members of the formation the impression that recovery was fairly normal. Too low a height would be their first indication of trouble and this when it was too late. This is probably the only type of difficulty which could thus confuse them. From examination of the wreckage it was quite impossible to determine whether such a restriction had occurred.

As leader, a pilot would continually cross-reference on his ASI and altimeter. An erroneous indication either by an altimeter malfunction or misreading could influence his key positioning. This would not, however, override his visual observations and orientation, and action could have been taken to initiate a more positive recovery.

A midair collision immediately prior to the aircraft striking the ground could have been a possible cause; however, it could only have occurred at a very late stage of the roll and in such a manner that it was not observed by the witnesses who watched the aircraft complete an aerobatic manoeuvre and dive into the ground.

The possibility that No 3 may have collided with the leader is not borne out by the observations of witnesses. Although No 3 was observed to break from the formation, this was due to his appreciation of the impending impact.

Lack of visibility on the part of the leader might have been a contributory factor. However, no substantial evidence to this effect was determined. While the final track of the formation was into the sun, the aircraft were on a downward path at the conclusion of the barrel roll. The angle of elevation of the sun at that time of day on the 15th August 1962 was 30° above the horizon; therefore, dazzle from the sun was not considered to have been a direct cause.

Close attention was given to the medical aspects of the investigation, particularly in the case of the formation leader. The fact that Lead had been subject to a medical board arising from an incident in Malaya was well known to many flying personnel at the time. This was the subject of a considerable amount of inaccurate gossip as soon as the accident became known, the reference being to 'blackouts' which Lead was said to have experienced. The medical conclusion was that there was no evidence of physical disability on the part of the formation leader contributing to the accident.

The final manoeuvre

A loose barrel roll is a very simple manoeuvre to carry out. The leader may have allowed the nose of his aircraft to drop to such a degree that recovery from the resultant dive was impossible.

The accepted objective in a barrel roll is to produce a helical flight path through 360° in the rolling plane and encircling a pre-selected point directly ahead of the line of flight. The selected point is normally on or slightly above the horizon. Ideally the flight path should describe identical symmetrical arcs above and below the horizontal level of the selected point.

To achieve this objective, one of the two following basic techniques is usually employed:

1. Entry to the manoeuvre is from a shallow dive directly towards the selected point and a turn of approximately 30° away from this point, in the opposite direction of the barrel roll. The nose is then raised and rolled, aiming to keep the 30° angle off from the selected point constant throughout the helical circumference of the roll.

2. Entry to the manoeuvre is from a shallow dive with wings level and on a flight path positioned to one side of the selected point, giving an angle off of 30° from this point. The nose is then raised to 30 above the selected point and rolled, aiming to keep the 30° angle-off constant throughout the helical circumference of the roll.

There are many variable factors which govern the flight profile during a barrel roll. The more important ones, each of which is variable, and all of which are controlled by pilot technique, are:

- the maximum nose-up flight angle achieved during the first half of the manoeuvre;
- the average rate of roll during the first half of the manoeuvre;
- elevator control technique approaching and passing through the inverted stage;
- the average rate of roll during the second half of the manoeuvre;
- elevator control technique during the latter half of the manoeuvre;
- the initial entry speed; and
- engine power setting used.

In the case of a sequence of aerobatics, the aircraft may commence a barrel roll from level flight at the conclusion of a previous manoeuvre, because adequate speed has already been acquired and the aircraft is at the minimum specified altitude.

Had the formation leader intended to perform a barrel roll about a horizontal axis, an error of judgment or faulty technique could have resulted in an excessive loss of height. If it were being performed at a very low altitude, then the safety margin would be reduced accordingly. In this instance the difficulty of recovering a formation from such a situation must be considered, especially as regards restricted manoeuvrability.

Contributory factors

Either or both of the following factors could have been an underlying cause of the accident:

1. The accepted practice of observing a minimum height of 500 ft for formation team aerobatic manoeuvres. It is apparent that the *Red Sales* were in the habit of executing formation aerobatic manoeuvres down to the minimum briefed height of 500 ft. If the formation had initiated their final barrel roll at a height of 1 000 ft, the accident would not have occurred.

2. Insufficient regular practice by the leader in performing the team aerobatic routine at low level. It is significant that subsequent to flying a total of four dual sorties and one solo lead sortie during practice sessions by the *Red Sales*, prior to the departure of the previous leader of the team, the leader had led the team on only four occasions, which were spread over a period of eight weeks.

Conclusion

Due to the very nature of this accident and the degree of aircraft breakup, post-impact examination achieved only limited results in some aspects. Consequently, there was insufficient evidence to isolate with certainty any underlying cause.

It was established that the accident to the formation resulted from failure of the leader to carry out timely recovery action when committed to a low-level aerobatic manoeuvre. Whilst the cause of the accident will never be positively known and certain speculation must always exist, credence must be given to the following three possibilities:

- An error of judgment or faulty technique on the part of the leader in executing a barrel roll to the left at low level.
- Foreign object restriction of elevator control movement.
- Physical disability affecting the leader.

However, the weight of evidence indicated that the accident occurred as a result of an error of judgment, or faulty technique on the part of the leader.